





Observing Europe: Networking the Earth Observation Networks in Europe 21-22 September, Paris

ENEON first workshop

Observing Europe: Networking the Earth Observation Networks in Europe

21-22 September, Paris



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1. About your network

1.1 Brief introduction about you and the network you are representing and the topic

- Central Bureau of EUREF Permanent Network (EPN)
 - Daily EPN network management
 - Information system: htpp://www.epncb.oma.be/
- EUREF Permanent Network
 - GNSS* ground stations tracking network (core network / densification network)
 - Data Analysis Centers & Coordinators
 - Data Centers : GNSS data and products
 - Central Bureau

* GNSS= Global Navigation Satellite Systems (GPS, GLONASS, Galileo,...)







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INTERNATIONAL ASSOCIATION OF GEODESY





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Brest, France



Matera, Italy



Sajarevo, Bosnia/Hercegovina



Vaasa, Finland







EUREF distributes GNSS observation data, meta-data and derived products to

- Maintain and provide access to the European Terrestrial Reference System (ETRS89) = INSPIRE datum for threedimensional and two-dimensional coordinate reference systems
- Support multi-disciplinary applications, such as
 - Ground deformation monitoring
 - Numerical weather prediction
 - Space weather applications (ionospheric monitoring)



1. About your network

- 1.2 How large is your user base?
 - National Mapping Agencies & surveyors
 - Access to European reference frame
 - Researchers
 - Geophysicists (ground deformation monitoring)
 - Meteorologists (nowcasting & numerical weather prediction) & climatologists
 - Space weather (ionospheric monitoring)
 - Contributors







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EPN Core network



CORE = 270+ GNSS stations, ~20 analysis centers, ~10 data centers,

100+ agencies: universities, research agencies, National Mapping and Carthographic Agencies, Private Compagnies

EPN Densification network



2500+ GNSS stations







Access statistics

- Data (core network), meta-data and products made available through distributed data centers: no access statistics available
- **EPN Central Bureau:**
 - Web site: 200.000 hits/month from 4000+ unique visitors
 - FTP site: 1 2.5 milj. hits/month (300 1200Gb/month)



1. About your network

1.3 What form of commitment do you have?

- Voluntary partnership
- Commitment letter signed by Agency
- How does it work?
 - Reliability through redundancy (avoiding single point of failure)
 - Quality above quantity
 - Extensive guidelines (operating standards, data flow, ...)
 - Quality requirements \rightarrow contributing is a synonym of quality



1. About your network

1.4 How is the cost of maintaining the networks (just to give an idea of the magnitude to be weighed against the benefits). Who are your funding sources?

EUREF Financial Plan (2014):

Stations & maintenance	2000k€ /yr		
Data distribution & Products	1200k€ /yr		
Quality Control, Management, Central Bureau	120k€ /yr		
TOTAL	3320k€ / yr		

Each agency assures its own funding



1. About your network

- 1.5 Do you have problems keeping your network running?
 - Not up to now, but long-term maintenance critical in some countries due to budgetary restrictions.
 - Most stations funded for surveying
 - Scientific (other societal) value is often neglected at national level
 - Strong point: *Quality above quantity*
 - (contributions are sometimes refused)
 - ightarrow Contribution to the network is considered as a quality stamp







2. About data

2.1 What data your network produces?









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Products







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Products focussing on reference frame

	1. Validated / Official Products							
No.	Product	Class	Sub-Class	Accuracy	Latency	Updates	Links	
1.01	Definition of ETRS89	Reference Systems and Frames	Definition	1 cm	-	-	ETRS89 home page	
1.02	Definition of EVRS	Reference Systems and Frames	Definition	1 cm	-	-	EVRS home page	
1.03	Transformation between ETRF and ITRF	Reference Systems and Frames	Transformation Parameter	1 cm	-	Simultaneous with new ITRF realisation	ETRS89/ITRS transformation	
1.04	ETRS/ITRF transformation service	Reference Systems and Frames	Transformation Parameter	1cm	Few seconds	On request	EPN coordinate transformation service	
1.05	CRS - Transformation between national coordinate system and ETRS89	Reference Systems and Frame	Transformation Parameter	1m	-	According supply by countries	CRS home page	
1.06	CRS - Transformation between National Height system and EVRS	Reference Systems and Frames	Transformation Parameter	1 - 10 cm	-	According supply by countries	CRS home page	







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Products derived from observations

1.07	EPN station coordinates Class A	Station	Coordinates	1 cm	15 weeks	15 weeks	EPN coordinates
1.08	EPN station velocities Class A	Station	Velocities	~1 mm/year uncertainty	15 weeks	15 weeks	EPN coordinates
1.09	EPN station coordinates Class B	Station	Coordinates	> 1 cm	15 weeks	15 weeks	EPN coordinates
1.10	Weekly coordinates of EPN stations	Station	Coordinates	0.5 - 1.5 cm	5 weeks	weekly	Weekly EPN solutions
1.11	Daily coordinates of EPN stations	Station	Coordinates	0.5 - 1.5 cm	3 weeks	daily	Daily EPN solutions
1.12	EPN station position time series	Station	Coordinates	1 cm	15 weeks	15 weeks	EPN position time series
1.13	Station coordinates of validated EUREF campaigns	Station	Coordinates	1 - 5 cm	1 year	-	EUREF campaigns
1.14	EVRF2007	Station	Physical Height	1 - 5 cm	-	5 - 10 years	EVRF2007
1.15	EUVN-DA	Station	Physical Height	1 - 10 cm	-	5 - 10 years	EUVN-DA
1.16	Hourly troposphere parameter for EPN stations	Station	Troposphere	4 - 6 mm ZTD	3 weeks	weekly	<u>EPN tropospheric</u> <u>delays</u>
1.17	GNSS broadcast satellite orbit correction	Satellite	Orbit	10 - 15 cm	real-time	10 sec.	<u>ASI broadcaster</u> <u>BKG broadcaster</u> <u>ROB broadcaster</u>
1.18	GNSS satellite clock correction	Satellite	Clock	0.3 ns	real-time	10 sec	ASI broadcaster BKG broadcaster ROB broadcaster







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Horizontal ground motion









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Vertical ground motion





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Non-linear ground deformations





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Tropospheric delays









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Standards & guidelines

	4. EUREF Standardization and Guidelines							
No.	Product	Class	Sub-Class	Accuracy	Latency	Updates	Links	
4.01	Guidelines for of EPN stations	Station	-	-	-	if necessary	EPN guidelines	
4.02	Guidelines for of EPN Data Centres	-	-	-	-	if necessary	EPN guidelines	
4.03	Guidelines for of EPN Analysis Centres	-	-	-	-	if necessary	EPN guidelines	
4.04	Guidelines for of EUREF densifications	Station	-	-	-	if necessary	EPN guidelines	







2. About data

2.2 What are the limits of your network (spatio temporal)?











2. About data

2.2 What are the limits of your network (spatio temporal)?

- 1-sec & 30-sec GNSS observations
- Daily, hourly and real-time data provision
- Daily, weekly & multi-year station positions
- Hourly tropospheric delays
- Real time satellite orbit & clock corrections



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2. About data

2.3 Is the data shared? To whom? In what conditions/license?

Open data access, no registration required For all data (core), meta-data and derived products

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2. About data

2.4 Do you address data quality in some way?

Yes!

One of the core tasks of the EPN Central Bureau! Daily quality checks of data and meta-data. Stations operators are notified in case of degraded data.

Essential activity guaranteeing the success of the EPN.







2. About data

2.5 Which data you know that is needed but is not captured by your network or by other networks that you have access to?

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Needed ... none







2. About data

2.6 What key interface standards do you use?

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Data exchange is done using international standard formats

- Observations \rightarrow RINEX: Receiver Independent Exchange format (or RTCM)
- Meta-data \rightarrow IGS Site Log
- Solutions \rightarrow SINEX: Software Independent Exchange Format

Data exchange primarily done using ftp.





2. About data

2.7 Is there risk of data continuity lost (Data preservation and data acquisition continuity)?

Data & Products (including historical) are stored at different (redundant) locations.

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Data acquisition can be interrupted at one GNSS station or stations of one brand (firmware issue), but not all stations simultaneously, unless general GPS, GLONASS AND Galileo outage.

Products depend on availability of satellite orbits and clocks from the International GNSS Service. No problems for final products (2-3 week delay).



3. About a network of networks

3.1 What interfaces do you have with other networks?

- IAG (International Association of Geodesy) IUGG (International Association of Geodesy (IAG) or and Geophysics) -> Sub-commission EUREF
- *IGS* (International GNSS Service): *European densification, use of IGS products, upload of solutions to IGS*
- **EPOS** (European Plate Observatory System) : building block of GNSS component, MoU planned, Interfaces will be defined and implemented during EPOS-IP project
- **EUMETNET** : MoU (data exchange)
- *EuroGeographics* (umbrella organization of the European National Mapping and Cartographic Agencies): MoU
- **CEGRN** (Central European GPS Geodynamic Reference Network): MoU
- Participating to some UN WG/Committees
 - ICG (International Committee on GNSS)
 - UN-GGIM WG on GGRF







3. About a network of networks

3.2 Are there additional interfaces that would be desired?

EUREF is

- European network
- No legal entity (sub-commission from IAG)
- \rightarrow No representation in global initiatives

More formal recognition would be welcome (national funding)







3. About a network of networks

- 3.3 Do you think that your network can benefit from the existence of an ENEON or a similar network
 - Improve visibility of added-value of GNSS observation networks
 - Provide some clarity in the jungle of organizations

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- Potential role of organization that coordinates activities in different countries
- 3.4 From you point of view how this network of network should be managed?







3. About a network of networks

network contributing to GEO(SS) 3.5 S your and how ConnectinGEO can help you in better participating?

Implicit through IAG and IUGG (and EPOS)

- But information about GEO(SS) is not flowing to our organization.
- More direct link with European part of GEO(SS) would be welcome to better acknowledge added-value of GNSS observation network (EPN) maintained by EUREF.



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More information

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http://www.euref.eu/